

## Upper Clear Creek Watershed (Colorado) – A Decade of Systematic Monitoring

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### Biographical Sketches of Authors

Dr. Steele's career encompasses nearly 38 years in water-quality hydrology and regional assessments of water resources. He has managed many multidisciplinary projects, hydrologic baseline and modeling studies for water-resources planning and management, and mining-related projects. He has consulted on projects dealing with hydrogeochemical interactions, ground-water contamination, aquifer and lake restoration, tailings disposal, hazardous waste/residuals management, design/evaluation of hydrologic monitoring networks, statistical analysis of hydrologic data, stream/subsurface modeling, use-attainability analyses, stream standards, total maximum daily loads assessments, regional ground-water planning, and international water-resources. He has given expert testimony and litigation support. He has developed and taught a short course on *Integrated Watershed Approaches – Monitoring, Modelling, and Management (The 3M Concept)*, offered at two German universities since the year 2000. He has been working as the water-quality technical advisor on behalf of the Upper Clear Creek Watershed Association since 1994, advising on its monitoring programs, conducting QUAL2E model applications, and participating in a range of watershed and stream-standards issues.

Mr. Abel is a professional engineer who has worked for the Colorado Department of Public Health and Environment in the Superfund program for the past 15 years. He is the project manager for the remedial investigation/feasibility study for Operable Unit #4 of the Clear Creek Superfund Site. His prior projects included managing the Argo Tunnel water treatment plant design and construction, a facility that treats acid mine drainage. He wrote the Record of Decision for the Denver Radium Superfund Site in 1992. Mr. Abel also has served as the Department of Health's construction procurement officer since 1997.

Ms. Fendel is a professional engineer with Leonard Rice Engineers, a water resources consulting firm located in Denver, Colorado. She is experienced in water quality standards, NPDES permitting, water quality monitoring, pretreatment, 404 permitting, Endangered Species Act compliance, and other Clean Water Act and Safe Drinking Water Act issues. She worked for the city of Golden (population 15,000) for ten years managing the water treatment division, utilities division and environmental services division and was responsible for environmental regulatory and compliance programs. Prior to that Ms. Fendel worked in water resources for the U.S. Environmental Protection Agency for 7 years.

### Abstract

Since 1994, a systematic water-quality monitoring-program network design has been in operation in the upper Clear Creek watershed, located west of the Denver metropolitan area in Colorado. The two major components are: (1) physical, nutrients, and sediment-related variables; and (2) trace metals (both total and dissolved species). At most monitoring sites, streamflows are recorded directly by the U.S. Geological Survey (USGS); otherwise, streamflows are estimated using interstation correlations. Examples of uses of the data include: (a) annual monitoring reports for the watershed; (b) evaluation of seasonal variability and long-term trends in the data; (c) assessment of loadings for selected variables (total phosphorus, and dissolved and total trace metals) which assists in identifying contributing source areas; (d) water-quality stream standards and determination of impaired water quality for specific trace metals; and (e) inputs to water-quality (QUAL2E and WMM) model applications. Finally, resultant data from this systematic program (currently 16 sites, with 8 sampling surveys annually) are evaluated and compared with other sources of water-quality data in the watershed (USEPA, USGS, CDPHE, CDOT, CDMG, and others).